Improvement of Pre-hospital Myocardial Infarction Alerts as a Measure for Increasing Value of Health Care Delivery in Patients with Suspected ST-Segment Elevation Myocardial Infarction

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Introduction

- Up to 800,000 acute myocardial infarctions (AMIs) per year in the U.S, with around 400,000 deaths[1,2]
- 38% are ST-segment elevation myocardial infarctions (STEMIs)[1]
- Rapid recognition and mobilization of resources in prehospital setting critical in reducing morbidity and mortality
- MI alerts allow communication between EMS and emergency room providers
- EMS delays account for 50% of system delay, coupled with inconsistent paramedic training on EKG interpretation[3]

Problem Statement

This project aimed to analyze how the changes in the pre-hospital MI alert pathway instituted by LVHN in 2015 affected door to balloon time and false MI alert rate in patients with suspected STEMI brought in via ambulance.

Methods

- Retrospective review of MI Alert Redcap Database - Dept of Cardiology
  - Timeliness, accuracy, demographics
- Data range: 4/4/2000 to 10/26/2021
- Feb 2015: LVHN EMI educates first-responders on ”NEAR” criteria
- Oct 2015: LVHN utilizes modems to electronically transmit EKGs utilizing LIFENET® system for units transporting patients to LVHN hospital ED’s
- Intervention: Combined use of NEAR criteria and pre-hospital ECG transmission
- Pre-intervention: 4/4/2000 to 1/1/2016
- Post-intervention: 1/1/2016 to 10/26/2021
- Door-to-balloon time (DTBT): length of time between arrival at the hospital ED and insertion of catheter/balloon in cath lab
- “False MI Alert”: any one of the following
  - Vetoed MI alert on presentation
  - False activation of pathway or false positive determination in ED
  - Primary discharge diagnosis not including ACS, AMI, STEMI, or NSTEMI

Tables and Figures

Figure 1. Changes to Pre-hospital MI Alert Pathway

NEAR Criteria: Feb 2015

- N: Narrow complex QRS (<120 ms)
- E: Elevation of ST segments (>1-2 mm in 2 or more contiguous leads or >= 2 mm in V2 & V3)
- A: Anginal equivalent
- R: Rate < 120 bpm

LifeNet EKG Transmission: Oct 2015

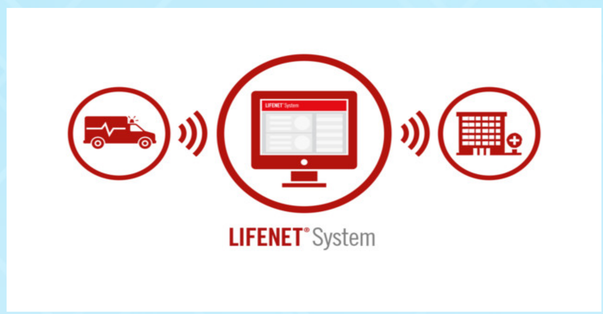

Table 1: Characteristics of the Patients with Ambulance Arrival to the ED.

	Overall	Study Period		
		Pre-Intervention n = 1,092(47.9)	Post-Intervention n = 1,188(52.1)	
Door to Balloon(min)	68(45,102)	**78**(55,111)	**56**(40,90)	<0.001
False MI Alert	1,062(46.6)	271**(24.8)**	791**(66.6)**	<0.001

Table 2: Odds of False MI Alert Among Ambulance Arrival Patients Post vs Pre-Intervention

	Unadjusted OR	95% CI	P	Adjusted OR	95% CI	P
Total Study Period	**6.04**	(5.03, 7.26)	<0.001	**6.21**	(5.11, 7.56)	<0.001

Table 3: Percent Change in the Door to Balloon Time Among Patients Arriving via Ambulance Post vs Pre-Intervention

	Unadjusted % Change	95% CI	P	Adjusted % Change	95% CI	P
Total Study Period	**-9.13**	(-6.51,-11.67)	<0.001	**-9.36**	(-6.62,-12.01)	<0.001

Table 4: Association between LifeNet EKG transmission, False MI Alert and DTBT in the Post- Intervention Period

	Unadjusted % change	95% CI	P	Adjusted % change	95% CI	P
Door-to-balloon time	**-17.07**	(-13.64, -20.37)	<0.001	**-16.83**	(-13.43, -20.10)	<0.0001
	Unadjusted OR	95% CI	P	Adjusted OR	95% CI	P
False MI Alert	**2.35**	(1.83, 3.04)	<0.001	**2.42**	(1.87, 3.13)	<0.0001

Discussion

- Previous studies have demonstrated that prehospital alerts significantly reduce DTBT and improve patient prognosis[4]
- High value health care
  - Increase quality: decreased DTBT and better patient outcomes
  - Decrease cost: prevent long-term cardiac complications and increased health care visits down the line if STEMI is treated earlier
- Increased rate of false MI alerts → increased utilization of resources → potential sources of waste in system
  - Per Lean principles, must balance improving clinical outcomes with practicing good resource utilization
- Limitations:
  - Single-center study
  - Lack of available data regarding cath lab results and patient disposition
  - Did not keep track of cancelled MI alerts (vs. vetoed alerts)`

Conclusions

- MI Alert pathway changes were associated with significant decrease in DTBT, potentially improving value of health care delivery
  - Future directions: cath lab results and patient disposition on discharge
- Increase in False MI alert activation, leading to increased resource utilization and waste per Lean principles
  - Future directions: adjust definitions of false MI alert and re-examine data as well as conduct QI study to identify ways to eliminate waste in MI alert pathway

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